SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

No. 1106.—Vol. XXVI.] LONDON, SATURDAY, NOVEMBER 1, 1856. [GRATIS.

THE COAL TRADE—ANTHRACITE COAL.

To a large proportion of those who are practically engaged in the consumption of fuels for steaming and manufacturing purposes, anthracite coal is only known by name; and through the combined representations, on the one hand, of those whose interest it has been to keep this fuel out of the market, and on the other of those who have taken upon themselves to speak and write down anthracite coal, without having tested its qualities, opinions have been formed, and prejudices entertained, which have to a great extent deterred the consumers of coal and coke from making a trial of this fuel. These prejudices are, however, gradually giving way, and by an oft-repeated series of experiments, made in different parts of the kingdom, the intrinsic value of anthracite coal is becoming better understood and more appreciated.

No better proof of the truth of this statement need be given, than the fact that the anthracite coal of South Wales is now finding its way into the very centre of the bituminous coal districts, and that it is consumed for manufacturing purposes in such counties as Cheshire, Lancashire, Staffordshire, Worcestershire, &c. It is in demand in those districts where high conditions of purity and heat are at the same time indispensable; and in some of such cases it has been found preferable to the charred coal or coke of those districts. Its constant consumption by some manufactures in the counties named is of itself a sufficient proof that it possesses peculiar advantages over the native fuel of those districts; for the cost of transit alone, in some instances, amounts to more than the marketable price of the best coke that can be purchased in the immediate neighbourhood. In London, the demand for anthracite coal is rapidly increasing for manufacturing and other purposes, especially where the absence of smoke and its concomitants is desirable.

At the Great Exhibition of 1851, anthracite coal was the only fuel consumed in the Crystal Palace for the purpose of raising steam in the boilers. This coal was produced from the seam known as the "Pump Quart Vein," which crops out in the Gwendraeth Valley, in the county of Carmarthen. Mr. Hensman, the superintendent of machinery at the Great Exhibition, speaking of this coal, says, "I find it of excellent quality, easily lighted, and with a very fair amount of flame, at the same time absolutely smokeless, a quality of the greatest importance in many cases, and here especially, where any smoke in the Park would be very objectionable—we now burn no other."

In the selection of coals for use, the first enquiry of the consumer should be, what are the peculiar combinations required for best effecting the purposes to which I intend to apply the fuel? If it be for the manufacture of gas, or some other such use, where the inflammable constituents peculiar to a bituminous coal are essentially in demand, then a highly hydrogenous coal, containing a large per centage of volatile matter, will be the most suitable; but if, on the other hand, a high degree of heat is in demand, and the absence of extraneous, earthy, and other objectionable substances, is desirable, if not indispensable, then a pure anthracite coal is the desideratum. Some of the best seams of the South Wales anthracite coal may be described as a mineral charcoal, already prepared for use. In this respect it is much superior to the generality of cokes offered for sale, which are frequently manufactured from bituminous coal dust, in combination with other earthy substances which are retained in the coke. This objection, also, applies to coke manufactured (even though it be) from large coals, providing they contain, as bituminous generally do, a considerable per centage of earthy matter, which cannot be separated by evaporation.

In the manufacture of coke, while sulphurous and other extraneous volatile substances are being carried off by evaporation, there is, at the same time, an enormous waste of the purer constituents of flame, which are entirely consumed or carried off by the same process that is put in operation to disengage the objectionable volatile materials. Now, could these purer constituents of flame be retained in the coke, it would, especially for steaming purposes, facilitate combustion, and considerably enhance the value of the fuel.

In a pure anthracite coal, we have, on the one hand, the absence (except in insignificantly small quantities, which are not appreciable in practice) of those earthly substances which are almost always to be met with in bituminous coals, and which no process of washing or evaporation can expel; and we have also a combination of just such a proportion of hydrogenous constituents as is sufficient to produce a pure, bright, blue-flame; and also to liberate the carbon in consumption with sufficient freedom, so as to command the most intense heat, without being carried off in the condition of soot; the whole of the process of combustion being completed and perfected in the furnace, or fire-place. Thus, while the fire continues to burn with a pure flame, and throws out an enormous heat, there is the entire absence of smoke.

Among a variety of objections which have been raised against the practical utility of anthracite coals, the following are the most prominent:—

1. It is objected "that the difficulty of lighting, and the slowness of combustion, are insuperable obstacles against the use of this fuel, where the great requirements are in rapidly getting up steam, and quick evaporation. Neither of these objections, however, apply to the best qualities of the South Wales anthracite coals. There are a number of different qualities of coals, which may be distinguished by the term "stone coals," or a sort of bastard quality, between the pure anthracite, the free, and the bituminous coals. These "stone coals" (I use the name here by way of distinction) are frequently as hard as stone itself; and, added to the difficulty of ignition and the slowness of evaporation, there is another objection to their general use, on account of the sulphurous and other objectionable substances which they almost invariably contain in large quantities. There is a song, addressed to that portion of the fair sex who have patronised the broad-brimmed hat, entitled "Who is your hatter?" Those consumers of coal who have had the above description of "stone coal" imposed upon them as a sample of South Wales anthracite coal, may be asked "Who is your broker?" for there are a certain class of small fry amongst these commissioned gentlemen with whom the more respectable class of colliery proprietors no more think of dealing than the Jew in the olden time would with the Samaritan. "A hint to the wise is sufficient."

A number of experiments were made at the College for Civil Engineers, Putney, by E. Frankland, Ph.D., F.C.S., on the seam of Anthracite coal, known as the "Pump Quart Vein," which I shall take the liberty of making use of in this paper, as I may require them to illustrate my statements. We are informed by that gentleman that they were subsequently "Conducted in the same manner, and with the same apparatus, as the comprehensive series of observations on the principal coals of the United Kingdom suited to the steam navy, made at the command of the Lords of the Admiralty; and hence these experiments admit of a true comparison with those published in the three reports presented to both Houses of Parliament, by command of Her Majesty."

The first series of experiments were made with the Government boiler, under the ordinary circumstances attendant on the use of bituminous coals.

	1st day.	2d day.	3d day.	4th day.
Fire lighted	9h. 30m.	9h. 50m.	10h. 3m.	9h. 13m.
Steam up	9h. 35m.	10h. 2m.	10h. 24m.	9h. 31m.
Weight of wood used	10 lbs.	10 lbs.	10 lbs.	10 lbs.
Initial temperature of water in boiler	199·4° F.	208·4° F.	205° F.	208° F.
Temperature of water in tanks	41·5° F.	46° F.	49° F.	48° F.
Barometer	30·05 in.	30·05 in.	29·87 in.	29·76 in.
Extremes of external thermometer	41°–43°	46°–50°	46°–48°	48°–52°
Extremes of internal thermometer	48°–53°	57°–58°	54°–61°	58°–64°
Dewpoint	47° F.	50° F.	49° F.	51° F.
Area of damper open	168 in.	112 in.*	56 in.*	168 in.*
Weight of fuel consumed	560 lbs.	740 lbs.	484 lbs.	670 lbs.
Weight of ashes left	10 lbs.	10 lbs.	8 lbs.	11 lbs.
Per centage of combustible matter in ashes	34·36	41·11	36·25	42·32
Weight of cinder left	16 lbs.	18 lbs.	18 lbs.	17 lbs.
Per centage of combustible matter in cinder	93·37	84·75	93·20	90·47
Weight of clinker in cinder	6 lbs.	10 lbs.	5 lbs.	6 lbs.
Average weight of soot in flues	none	none	none	none
Weight of water evaporated	5095 lbs.	6780 lbs.	4940 lbs.	6230 lbs.
Weight of water evaporated from 212° by 1 lb. of coal	10·99 lbs.	10·67 lbs.	11·92 lbs.	10·72 lbs.
Weight of coals per hour per square foot of grate surface	14 lbs.	18·5 lbs.	12·1 lbs.	16·8 lbs.
Weight of water evaporated from 212° by 1 lb. of coal, after allowing for combustible matter in residue	11·12 lbs.	10·97 lbs.	12·43 lbs.	11·08 lbs.
Duration of experiment	8 hours	8 hours	8 hours	8 hours
Specific gravity of coal	1·391	——	——	——
Mean weight of 1 cubic foot	67 lbs.	——	——	——
Economic weight or space occupied by 1 ton	33·43 c. ft.	——	——	——
Cohesive power of coal	87·5	——	——	——
Final temperature on fifth morning	205° F.	——	——	——

* In these experiments the steam was blown off into the chimney, to increase the draught.

Comparing these returns with the results obtained with the best coals of the United Kingdom, by the same apparatus, it may be observed that the anthracite coal bears a most favourable comparison.

The following table shows the highest results thus obtained, as compared with those of anthracite coal, as set forth in the above table:—

Name of fuel.	Evap. power, or No. of lbs. of water converted into steam by 1 lb. of coal.	Weight of cubic foot in lbs.	Space occupied by 1 ton in cubic feet.	Cohesive power per cent. of large coals.	Evap. power, after deducting for combustible matter in residuum.	Evap. power per hour per sq. foot of grate surface.	Pounds of clinker per ton.
1.* Pentrefelin	6·36	66·17	33·85	52·7	7·4	40·6	22·7
Duffryn	10·14	53·22	42·09	56·2	11·8	69·8	—
Ebbw Vale	10·21	53·30	42 26	45·00	10·64	90 5	9·3
Hill's Plymouth Works	9·75	51·20	43·74	64·0	10·18	119·8	7·5
Dalkeith Jewel Seam	7·08	49·8	44 98	85·7	7·10	63·0	62·2
2.† Johnson & Worthington's.	6·32	51·6	43·41	82·0	6·22	80·5	34·4
Warlick's	10·36	69·05	32·44	—	10·60	96·5	29·7
Anthracite coal, "Pump Quart Vein"	11·08	67·0	33·43	87·5	11·40	127·4	24·6

* 1. Bituminous, free-burning, and other coals, taken from Admiralty reports.
† 2. Patent fuels, taken from Admiralty reports.

The above abstracts from the "Admiralty Reports," each of them represent one or more of the highest favourable conditions specified in the headings of the table; but it will be observed that in no case are all the favourable conditions so well sustained by any of the fuels represented in the Admiralty Reports, as they are in the anthracite coal.

Sufficient has been written to show that this first objection cannot be sustained, but we must necessarily recur to it again in meeting the next.

2. It is objected that in the consumption of anthracite coals the heating effect is principally confined to the furnace, or fire-place, while the flues are devoid of flame, and, consequently, the heating area to which the surface of the boiler is exposed is considerably reduced, and from the same cause the iron-work in the fire-place is seriously injured.

There will be no difficulty in showing that the above condition is, when brought under proper control, rather an advantage than an objection, and is peculiar to the use of anthracite coals.

In the consumption of bituminous coals the difficulty has always been, and still remains, to complete the consumption of the combustible gases of the fuel in the furnace, before they ascend the stack or chimney. A bright flame of fire may very frequently be seen issuing from the tall stack, while, at the same time, in the fire-place a black cloud of smoke puts all into darkness. Notwithstanding the numerous patents which have been taken out for the consumption of smoke in the furnace, and the legislative enactments by which they have been backed, and which go to forbid the appearance of smoke in our atmosphere, the chimneys of our manufactories and steamers still pour forth their black sootty fumes in every direction, and bid defiance to Acts of Parliament with a lawless majesty. The combustible constituents of the fuel of bituminous coals are thus, to a very considerable extent, carried off unconsumed in the condition of smoke and soot. On the other hand, all the combustible constituents of the anthracite coals are completely consumed in the fire-place, causing a most intense heat, which can never be attained with any other description of fuel under the same circumstances; and all that remains necessary is the appliance of some means to distribute that heat around the flues of the boiler.

The application of the steam-jet under the fire-bars is all that is necessary to effect this purpose. A small pipe of $\frac{3}{8}$ or $\frac{1}{2}$-in. bore, conducted from the boiler, and across the under side of the bars, where a number of perforated holes are inserted, together with a regulating steam-cock, constitutes the whole of this apparatus; or, what would still increase the effect would be another pipe of the same size, running across the top of the fire-place, just inside the furnace door, where it should be perforated with very small holes. Steam thus introduced through or over the carbonacious substance of the burning fuel, produces hydrogen and carbonic oxide gases. Both of these gases, on subsequent combustion, generate large quantities of heat, without the production of, or trace of, smoke or soot. The great advantage of the steam-jet, however, consists in the distribution, at the will of the fireman, of the heat throughout the entire area of the flues, which would otherwise be evolved in the fire-place. The steam is supposed to dissolve, as it were, the carbon from the ignited coal, and carry it into the flues, there to be burnt. I may add that the above is not a visionary, impracticable theory, but it is a plan which is now adopted with astonishing success by some consumers of anthracite coals.

The following series of experiments with the steam-jet were made with the Cornish boiler, at the Putney College:—In this case the steam-jet was brought from an additional tubular boiler, and not from the experimental one. The weight of coals in these experiments which were consumed in the small boiler was added to that of those burnt in the Cornish boiler, which was thus debited with them This arrangement would, no doubt, considerably increase the quantity of fuel consumed.

The following results were obtained:—	1st day.	2d day.
Fire lighted	10h. 20m.	10h. 17m.
Steam up	10h. 55m.	11h. 4m.
Weight of wood used	10 lbs.	10 lbs.
Initial temperature of water in boiler	174° F.	194° F.
Temperature of water in tanks	50° F.	48° F.
Barometer	29·33 in.	29·51 in.
Extremes of external thermometer	44°–47°	37°–41°
Extremes of internal thermometer	55°–65°	52°–61°
Dewpoint	49°	46°
Area of damper open	112 in.	56 in.
Weight of coals consumed	850 lbs.	600 lbs.
Ditto, under tubular boiler	24 lbs.	20 lbs.
Weight of ashes left	7 lbs.	9 lbs.
Per centage of combustible matter in ashes	37·28	36·46
Weight of cinder left	17 lbs.	19 lbs.
Per centage of combustible matter in cinder	88·43	93·39
Average weight of soot in flues	none	none
Weight of water evaporated	7760 lbs.	6105 lbs.
Weight of water evaporated from 212° by 1 lb. of coal	10·47 lbs.	11·55 lbs.
Ditto, after allowing for combustible matter in residue	10·69 lbs.	11·95 lbs.
Ditto, ditto, and coal burnt under tubular boiler	10·77 lbs.	12·36 lbs.
Weight of coals per hour per sq. foot of grate surface	21·3 lbs.	15 lbs.
Duration of experiment	8 hours	8 hours
Final temperature on third morning	201° F.	

On the result of these experiments Dr. Frankland remarks:—"The results of these experiments are highly satisfactory, and fully prove the applicability of the plan to the rapid production of steam by anthracite coals. This increase of evaporation from equal grate surface, the conditions of draught, &c., remaining the same, is clearly seen from the following comparison:—

Area of damper open	112 in.	56 in.
Weight of water evaporated per hour per square foot of grate surface, without steam	169·5 lbs.	123·5 lbs.
Ditto, ditto, with steam	194 lbs.	152·6 lbs."

The separate boiler for the generation of steam used beneath the bars, together with other circumstances attending these experimental trials, bring the results down far below what can be effected in practice.

This steam-jet is the most manageable thing that can be conceived. By the turning of the cock attached to the pipe between the boiler and the furnace, the distribution of the heat through the flues is regulated at pleasure, and a beautifully clear fire and bright flame produced.

The use of the steam-jet has produced astonishing results in the calcination of iron ores. Instead of the old system of clamping on the open bank, the ore is placed in a calciner, or kiln, similar in some respects to a lime-kiln, nearly at the lower part of which is attached a small furnace. A hot blast-pipe is introduced under the bars, which can be kept from burning, either by the application of water tubes or a steam-jet underneath them. Inside the door of the furnace, a perforated pipe passes within a few inches of the arch, and when the steam is turned on the ignited combustible gases are distributed through the descending mass of ore, while it passes the furnace at a white heat, which can be regulated or increased to any required extent, at pleasure. The ore is removed at a lower level, on the other side of the kiln, in a calcined state, and from thence direct to the furnace. One cwt. of anthracite coal will calcine a ton of mine to an almost fusible state if required, and with this desirable result, that it is done to your own pleasure, and without the admixture of those earthy and other substances always attendant on the old clamping systems; and what is always a pleasing feature, this simple and inexpensive process is not dubbed with any "letters patent."

But to return from this digression. We have established the point that the heating effect of anthracite coal being confined to the fire-place is an advantage rather than otherwise. It remains there under the complete controul of the fireman, and only waits his bidding to diffuse itself throughout the whole area of the flues. We have also shown how capricious and unmanageable the combustible gases are, which form the most valuable part of the fuel of bituminous coals, while undergoing decomposition in the furnace. It would appear that the excess of volatile matter in this last description of coals causes the carbon to be decomposed at a much quicker rate than it can be consumed in the furnace, whilst the expansion of the heated atmosphere carries this smoky volatile product off into the chimney, at the top of which, if the heat be sufficiently intense, it becomes ignited on receiving an increased supply of the oxygen of the atmospheric air. On the other hand, in the case of a pure anthracite coal, the relative quantities of this gaseous and volatile matter with the carbon is so nicely poised as to cause the decomposition of the latter, at such a rate, and under such peculiar conditions, that the combustion shall be completed without leaving the least trace of smoke or soot.

It will be seen that the evaporative power per square foot of grate-surface of the Pump Quart Vein of anthracite coal is demonstrated to be much greater than that of any fuel experimented upon at the Putney College, as published in the Admiralty Reports. The highest evaporative power there reported being 119·8, while the anthracite coal reached 194, with the assistance of the steam-jet. By another experiment made at the Putney College with this coal, as compared with the Tankfield coke, it was found that 1 ton of the anthracite coal evaporated an equal quantity of water with 1 ton 6½ cwts. of the above-named coke. An experiment was also made in a locomotive boiler used foragricultural purposes, in which it is stated that "the conditions of draught, &c., were as near as possible the same as in an ordinary locomotive."

The result of this experiment is reported by Dr. Frankland as most satisfactory, "The anthracite produced an intensely bright fire, and an enormous evolution of steam."

The following are the particulars of the reported experiment:—

Fire lighted	10h. 43m.
Steam up	11h. 43m.
Weight of wood used	10 lbs.
Initial temperature of water in boiler	42° F.
Temperature of water in tanks	49° F.
Barometer	29·17 in.
Extremes of external thermometer	43°–54°
Dewpoint	49° F.
Weight of coals consumed	459 lbs.
Weight of cinder left	7 lbs.
Per centage of combustible matter in cinder	64·63
Weight of water evaporated	4400 lbs.
Weight of water in boiler at commencement and close of experiment	1265 lbs.
Weight of water evaporated from 212° by 1 lb. of fuel	11·60 lbs.
Ditto, after allowing for combustible matter in residue	11·72 lbs.
Weight of coals per hour per square foot of grate surface	16·4 lbs.
Duration of experiment	7 hours
Final temperature of water in boiler	212° F.

Another advantage of the best qualities of anthracite coals is that, as a rule, they do not occupy anything like the same space as is taken up by the same given weight of bituminous coals. The great superiority of the Pump Quart Vein over any other coal tested (according to the report before alluded to), places this anthracite beyond the reach of any fuel before experimented on at that institution. One cubic foot of this coal was

found capable of converting into steam 742·36 lbs. of water, being an excess of about 160 lbs. over any bituminous or free burning coal there tested. The following analysis of this anthracite coal, by Dr. Lyon Playfair, C.B., F.R.S., will not be uninteresting to the practical reader :—

Carbon	91·16	Sulphur	·86
Hydrogen	3·21	Ash	1·12
Oxygen	2·74		
Nitrogen	·91		100·00

We have dwelt more particularly on the Pump Quart Vein of anthracite, simply because the experiments made at the Putney College were within our reach, and it may be taken as a type of the purer anthracite coals of South Wales. At the same time, we are aware that other seams of anthracite within this district contain a larger per centage of carbon than is here set forth; but whether the practical uses exceed those of the Pump Quart Vein, in the absence of authenticated experiments, we are not prepared to state, although we have no doubt that several of the other seams of the South Wales anthracite are quite equal to this vein.

The general places of consumption are copper and iron furnaces, distilleries, malt kilns, brick kilns, lime kilns, steam-vessels, glass-works, tallow-chandlers, public buildings, prisons, &c. And for some, if not most of these purposes, there is, to make use of an old phrase, a regular sending of coals from South Wales to Newcastle; for this anthracite coal finds its way to most parts of this kingdom, and to Ireland.

The use of anthracite coal in the blast-furnace introduced quite a new feature in the consumption of this novel fuel. Although several furnaces are now at work in the anthracite coal districts, some of them consuming no other fuel, and producing iron of a superior quality at a most economical rate, still the use of anthracite coal for furnace purposes is quite in its infancy; and we feel fully satisfied that the time is not far distant when these anthracite iron furnaces will be built on a scale which will leave in the shade the gigantic furnaces of the Dowlais and other districts.

Here, in these anthracite coal districts, is a fine field for the operations of the enterprising capitalist. Here, in every direction, lie immense tracts of maiden land, under which are deposited seam upon seam of bright pure coal, intersected with iron mine in unlimited quantities, and immediately surrounded with mountains of limestone, thus affording every facility for the economic working, and within easy distances of canals and railways.

When we pass over these unworked fields of mineral treasure, and on our return home take up your valuable Journal, and read from time to time your independent and able comments on the exploded schemes of these foreign adventures, the wonder is that the English capitalist should be so short-sighted as to pass by these inexhaustible treasures, that are within the reach of his own daily observation, and allow himself to be made the dupe of some adventurous scheme in a foreign land, which, as a rule, ends in wreck and ruin. Here there is no adventure in the case. The seams of coal as they crop out protrude themselves on the very surface, and the cottager and the farmer have for ages worked them according to their small requirements. The seams are also correctly indicated on the Ordnance Maps; and the country is here and there bisected with small collieries, where the various seams have been proved; and these collieries serve as so many bench marks, pointing out with sufficient certainty the directions of the mineral produce of the country. One peculiar advantage is, the producer can, to a great extent, become the consumer. He raises his iron ore, and also his coal, which he consumes in the furnace. He may carry his operations further, either in the direction of the puddling furnace and rolling mill, or the capels. It is a fact which deserves to be more generally known, that excellent castings are now being produced in this district with the use of no other fuel in the cupola but anthracite coal.

The following is a summary of the advantages of anthracite coals over all other fuels experimented upon :—

1. Its high evaporative powers.
2. The smallness of space occupied, as compared with other fuels.
3. The remarkable cohesion of its particles.
4. Its comparative freedom from sulphur.
5. It does not progressively decay; a very important consideration in shipping, as it gives a sure guarantee of non-liability to combustion.
6. It is perfectly smokeless.

As we have before observed, the supply of this fuel is almost unlimited in South Wales. The existing collieries only represent, in point of magnitude, a few workings on the crop of the seams, while the great bulk of the basin remains untouched, and biding the time when English capitalists shall turn aside in disgust from foreign mining, and native joint-stock banking schemes, to the development of real *bona fide* resources in coal and iron with which this country abounds in unlimited extent,—resources already proved and developed, and which consequently put the terms trial and adventure out of the category of the phraseology necessary to be used in discussing the formation of a company for the working of anthracite coals in the South Wales district.

MINERAL WEALTH OF CHILI.

It may interest some of your readers to learn that the rich metalliferous districts of Chili are attracting considerable attention here, and that they are likely to receive in a few years hence a large addition to their population, in the shape of French emigrants. The different republican States of South America have always been in favour with south Frenchmen, but their chronic revolutions and general insecurity have somewhat cooled the Gascon and Provencial ardour for trying fortune in the new world. The state of Chili is, however, an exception; the tranquility and order that have reigned there, and that have reigned for years past, joined to the perfect liberty people enjoy, form the theme of all letters received from settlers. Now, when California is used up, and Australia grown out of all romance, adventurous spirits turn their eyes elsewhere: by adventurous, it must not be supposed turbulent spirits are meant. Future colonists will not be of that *trempe*, but simply persons who are willing to adventure largely to be able to live freemen. A recent letter, dated Valparaiso, June 28 of this year, and published in official documents, states that the climate of Chili is temperate and healty, very favourable to Europeans who can undertake out-door work, without danger to their constitutions, and without inconvenience. Nevertheless, and in spite of these advantages, the current of emigration has not yet taken this direction. Probably the distance of the journey, the dangers of rounding Cape Horn, and the natural hesitation of intending emigrants to settle in a country of which comparatively little is known, have contributed to the present state of things. The Chilian Government, however, neglects no resource to attract colonists to a land which contains not less than 65,486,910 acres (without counting Araucania), and which produces in abundance grain, trees, and fruits of the finest kind. In the southern portion of the country, in the territory of Llanquihue, near the lagune of that name, is to be found the only foreign or European colony that has been established up to the present time. It contains 247 colonists, including women and children. Unfortunately, this centre of agriculture is too remote from any town or village, and the road leading to the port is in a very bad state during the greater part of the year, in consequence of the marshy state of the ground, and partly from its not being kept in proper order. The former intendent of the territory has been sent to Europe, charged to obtain emigrants for the south of Chili, and in addition a commission has been named at Santiago to provide, through the mediation of properly appointed agents, for the reception and due location of colonists. If, however, the emigration of agricultural labourers is, up to the present time, of little importance, the same cannot be said of the emigration of artizans; vessels from Europe, particularly French clippers on the Havre and Bordeaux lines, land yearly at Valparaiso a considerable number of carpenters, blacksmiths, locksmiths, contractors, gardeners, coffee-house keepers, &c.; chemists, doctors, and merchants are also among the number.

THE METAL TRADES.—A very useful Chart, prepared by Mr. Johnston, metal merchant, of Glasgow, is now ready: it contains, amongst other information of the greatest interest to all connected with the metal trades, an elaborate diagram, showing at one view the prices of the principal metals during the past 16 years, the Birmingham wire and metal guages and the modern Belgian zinc guage, the weight and thickness of lead piping of various diameters, &c., thus forming a valuable work of reference for the counting-house of the iron merchant or broker. Copies may be had at the office of the *Mining Journal*. Price: Mounted, on rollers, 21s.; on plain sheet, 10s.

Original Correspondence.

COLLIERY OPERATIONS—SPECIAL RULES.

SPECIAL RULES FOR THE CONDUCT AND GUIDANCE OF PERSONS ACTING IN THE MANAGEMENT OF COLLIERIES, AND OF ALL PERSONS EMPLOYED IN OR ABOUT THE SAME, IN THE SOUTH STAFFORDSHIRE DISTRICT. ALLOWED BY SIR GEORGE GREY, ONE OF HER MAJESTY'S PRINCIPAL SECRETARIES OF STATE.

SIR,—The special rules for regulating the conduct of those engaged in coal mines are so important in their social and political aspect, and have been so frequently the theme which has exercised your abilities as the advocate of system and order, that it would not be right to allow a publication of this kind to be sent amongst the colliers, without a passing comment on its fitness to accomplish the object for which it has been written. The rules, which now lie before me, are addressed, by permission of Sir George Grey, to the ground bailiffs, engine tenders, banksmen and hookers-on, charter masters, and colliers of South Staffordshire district, with the laudable view of guiding them safely through the many dangers which beset their daily path on every side. The practice and conduct which these rules are intended to correct show, in an unmistakeable way, the almost total disregard of the ordinary precautions against accidents, and an ignorant carelessness of human suffering; and, certainly, they have not been framed before their necessity was made obvious to every sensible man. There must have been a greater laxity in the discipline of the colliers, and in the management of the collieries in South Staffordshire, than in any other mining district with which I am acquainted to render necessary the following rules :—The engine tender is commanded to cease working in case any defect be apparent of a nature to endanger life; he is not to leave the hand-gears whilst men are ascending or descending the pits, nor work more than two turns, that is day and night, continuously. The banksman is not to allow any man in a state of intoxication, or boys under 12 years of age, unless with a man, to descend the pit, nor is he to allow any person to descend against a loaded skip, or bye-chain. The hooker-on shall not allow any person to ascend on a loaded skip. Every collier shall securely sprag the coal while holing, and where safety-lamps are used no person shall be allowed to "blast" coal without the permission of the manager. Never in my experience in the coal mines of Nottingham, Durham, Derby, and Leicester, have I seen anything approaching to such a recklessness of danger and hardihood of purpose which have developed the necessity of instituting such regulations as those to which I have just alluded. Would any man in his senses ever think of acting, in the midst of danger and death, in opposition to these very obvious and axiomatic laws? I never knew them to be infringed upon except by accident, and it strikes me forcibly that there has been, if it does not still exist, a deeper and a more unholy cause for such a wretched state of things than simply the ignorance and stupidity of a few colliers. But, however, the special rules have not been framed before they were clearly required, and the only question is, have they been drawn up by the right individuals, of skill and experience; have they been dictated by parties most interested in their success, and whoare best able to carry them to a successful issue? The response to these enquiries is to be found in the dissatisfaction which has been manifested by the mine agents and ground bailiffs of South Staffordshire; and it is also the best testimony against the fitness of the parties to whose care these important regulations have been entrusted. The following are a few rules, for the execution of which the manager or ground bailiff is responsible :—

1. "That the roads in the pit are, in all cases, well and properly secured and timbered where required." Who shall determine when a bank or gateway is properly timbered? it may be safe one hour, and the next a weight, as it is called, may come on and render such a place highly dangerous.

2. "That every airway is travelled as often as may be necessary." This rule is too indefinite; who is to fix the time necessary for travelling the air-courses?

3. "That where a shaft is so far from vertical as to endanger the safety of the men, that it is widened in the best way practicable."—"And that all pits are so constructed that the hooker-on can perform his duties without standing in the shaft when a load is ascending." These two rules are quite sufficient to show the loose way in which the coal mines of Staffordshire have been conducted, and I believe that it is the only place in England where a hooker-on would ever think of standing in the shaft while a loaded skip was ascending. How men can be found to perform such duties I cannot comprehend.

4. "That no chains or ropes are used which, in the opinion of the manager, are overworn, or seriously damaged."

In viewing this rule from a distance, it does seem a little marvellous that there should be, in South Staffordshire, managers of collieries in which the greatest dangers and casualties prevail; who can so far forget their duty to the public and humanity as to allow ropes and chains to be used, in drawing men, living souls, up and down a deep shaft, when in their individual opinion—that is, when they thoroughly believe—such ropes and chains are seriously damaged, and, therefore unsafe to be any longer used. I can scarcely picture to my imagination the existence of such managers in a Christian land, and, therefore, I would fain believe that such a rule is not applicable in South Staffordshire, or in any other district. The manager, or bailiff, cannot be responsible for the due performance of the 11 rules which are placed immediately under his name; he can only be responsible for appointing suitably recognised individuals to perform such duties, and they must be responsible for their being fully carried out.

The second and third rules for the guidance of the bailiff are too indefinite to be of much service; he is commanded to "examine, frequently, the state of every engine and boiler, and of the winding-machinery, and winding-ropes or chains at every pit under his control." The framers of these regulations, as if conscious of the managers' or bailiffs' inability to discharge such duties effectively, are now considerate enough, and state that he (colliery engineer, manager, or ground bailiff) "shall cause every steam-engine boiler in his charge to be cooled down, emptied of water, and thoroughly cleaned out and scraped, and the flues of every such boiler swept, at such times as may be necessary." Has not experience in these matters sufficiently developed their laws of action, so that the times of performing these operations shall be definitely limited?

The engine tender is "to examine at least once a day the machinery, boilers, and other apparatus connected with the engine and pits." The machinery and apparatus connected with the mines of South Staffordshire must be exceedingly simple, when compared with those of other mining districts, for one man to examine daily the boiler, machinery of the engine, and pits, in a way to be of any practical value; surely this cannot be the meaning of the rule. Where is the jurisdiction of the engine tender to cease? Is he to go down the pit once a day, and examine the apparatus there used, or is it simply the machinery at the pit bank he is to examine, such as the chains, tackle, pulleys, headstocks, &c.? Does not this rule demand reconsideration? What can be the use of placing duties in the hands of men who are unable to discharge them with advantage?

The banksman shall be responsible for the state of the pit top, that the frames are kept free from dirt, and the guards are regularly put up, and all other apparatus at the pit top are kept in proper repair. I will not enquire whether the qualifications of men usually employed in this capacity will justify the framers of these regulations in entrusting such important duties to their care and management, but simply ask, Do they not clash with those duties assigned to the engine tender? It seems to me to be one of the greatest defects of these special rules that the framers of them have fixed the responsibility of the same duty upon two or more parties. For instance, the hooker-on has to "see that the sump is covered over before any person is allowed to descend;" and the charter master, or his deputy, is to "be responsible for the scaffolding being replaced over the sump, immediately upon the water being drawn out, and for the sump never being left uncovered whilst the pit is at work." It may be that men want to ascend or descend the shaft during the time the sump is being emptied, still I see no reason why the responsibility should be divided. The charter master, or his deputy, in the examination of the workings, is to use "safety-lamps if necessary." When is it necessary, and under what circumstances are safety-lamps to be used, is a pertinent enquiry, and one to which the framers of these rules should have directed a little attention.

The rules for the guidance of the colliers themselves, with one or two exceptions, are, in my opinion, very good: the 28th would be all the better for a slight alteration, as the want of a sprag seems a paltry thing to drive a holer to bank to see the manager, and report the circumstances to that officer. In conclusion, I feel convinced that it would have been attended with advantage, had the parties more immediately interested in the obedience of these special rules been invited, by deputy or otherwise, to take a part in framing them.—*Oct.* 22. COAL MINER.

PRACTICAL MINING—ENGLISH AND FOREIGN MINERS.

SIR,—To those who have for years perused your Journal, although these remarks may be read with interest, yet they will be wanting in one ingredient—that of novelty—for I am merely again about to reiterate that which has been so often the subject of discussion in your columns. It appears that at the Polytechnic Society's meeting, at Falmouth, the Rev. Mr. Pannett delivered a speech somewhat condemnatory of the acquirements of our home miners, and this has provoked the ire of several of our mining agents, who enquire of him how they are deficient, and in most elaborate statements show that in practical knowledge they are superior to the German or other foreign miners. Mr. Tonkin enquires who it is that manage mines in North America, Lake Superior, California, Mexico, South America, Australia, New Zealand, Norway, Spain, and, to some extent, in Germany itself? Neither in California or Australia, judging from the results arrived at, can the palm be awarded to our mining captains since the gold discoveries have occurred. It would appear in these localities that merit should be awarded to the man who could earliest spend the money subscribed by the shareholders, and by that means wind-up the company. At Copiapo, the principal mining agent, Senor Notango, is a native of Chili. In Spain, under Cornish superintendence, all know what a great failure, after an expenditure of 240,000*l.*, the Asturian Mining Company has been. The Mexican mines are now but of little import; while Mr. S. H. Thomas, of Gwennap, the manager of the Alten Mines, the only Cornish manager in Norway, did not attain to that position until he had been under successive directions, composed of men of business habits and mercantile knowledge.

Mr. Tonkin enquires why it is that the most enlighted and scientific gentlemen of our country, when they invest their capital, employ Cornish agents? This question is easily answered. In the first place, they are known; and, again, if it be requisite to get up a she a company, that gentleman must be perfectly aware that an agent's name must be appended to the report. Those connected with mining know on whom they have to depend: not so the general public. But we are sorry to say there are some who make reports contingent, with a per centage, of the mine being taken up, and the shares going off well in the London market. Another writer states it as his belief that the step now taken is an inefficient one for the benefit of mining. This gentleman mentions that at the Louise Mine there was a Cornishman who had fixed the pumps and rods, and he believed he could not write his own name, nor read a word in his own language. He likewise cites great mismanagement at the Arenaew Mines, near Cologne, and the Obernhof Mine, in the Duchy of Nassau, about fifteen miles from Coblentz.

It is not my purpose here to give long extracts from these reports; I do not believe they would afford any further elucidation of the question. Neither am I about to impugn them in any way; I will, therefore, assume them to be correct. The most common observer who has ever travelled in Germany must have noticed that they are not a practical people; they are enthusiastic, bursting with ideas they never carry out. All must remember the year of revolution, 1848, when all the country was in arms; the cry then was, "Only one Germany." What was the result? It ended in nothing. In details, following red tape and routine, the German is an apt disciple, but for an emergency he neither possesses the nerve or the determination of an Englishman. While the one is carrying out an undertaking, the other is studying the minutiæ, and, consequently, when real work is to be performed, the one who seizes the opportunity will be always successful where the other fails. I have always stated that, as far as practical knowledge is concerned, the English miner is fair superior to his foreign competitors. He can get through double the labour in half the time, is more ready at an emergency, and if properly governed, and fairly managed, in a foreign county he becomes a most valuable assistant; yet we believe that, were he to receive a proper education it would not deteriorate from his merits, but rather enhance them. The present system of teaching adopted by the Government School of Mines, and their adjuncts in the several local districts, it cannot be supposed will be satisfactory to all parties. There are prejudices to be overcome, and obstacles to be encountered, which at the formation were never thought of. These, however, time will obviate, and I have no doubt but that in the course of a few years the advantages of these institutions will be fully appreciated. I by no means wish to infer that a course of training at these educational establishments will make a miner; he must have practice as well as theory, and the study of the latter will cause him to acknowledge the merits of the former.

There can be no doubt but that a discussion of the question must be productive of good: I would only recommend that it should be conducted in a less acrimonious spirit than has hitherto been the case. My earnest desire is to see that mining should be placed on that prominent footing which such an important branch of industry demands. All must acknowledge that although our miners have long been known and celebrated for their practical ability, yet in many technical points they have failed, and hence the collision which has occurred between them and foreigners in countries where both are aliens.

I do not believe it is either the wish or intention of the Government School of Mines to introduce too much of the German element into our mining education; they are, no doubt, actuated by right motives. Much of our mineral resources are yet undeveloped. Copper ore was worked in Germany long before its use was known in Cornwall. The discoveries of lead are of comparatively recent date there, and much yet remains to be explored. Let no stiff-neckedness prevent us, no matter how practical and utilitarian we may be, from learning from our neighbours: however self-opiniated a person may be, he has still something to acquire, and an interchange of ideas often produces great results. If the English miner, with his great practical knowledge, would engraft on it some of the German science, divested of its trifling minutiæ, he would find it beneficial to "One and All." J. WILLIAMS.

Helstone, Oct. 21.

ON THE STRATIFICATION OF ROCKS.

SIR,—Having lately read in your valuable Journal many exceedingly interesting letters on the Formation of Mineral Veins, I beg to inclose you a copy of a paper read before the British Association, by Mr. J. Leathart, on the "Stratification of Rocks." I believe this paper will be read with peculiar interest by your readers, and its publication will do honour to the memory of its deceased author, formerly a respected mine agent of this district. The circumstances which suggested to the author to make public the views contained in a paper on the Stratification of Rocks, read to the Geological Section, at the meeting of the British Association for the Advancement of Science, held at Newcastle-upon-Tyne, was the great number of applications made to the author for copies of the paper, which his professional duties would not admit of his furnishing in writing.—*Alston, Oct.* 28. AN OBSERVER.

ON THE STRATIFICATION OF ROCKS.

On examining the solid crust of the earth, we find that the uppermost parts are composed of the superficial soil, which is generally formed of the disintegrated particles of the adjacent rocks, reduced to a fine powder, more or less mixed with decayed vegetable and animal remains. Beneath this we frequently find, on one or both sides of hills, diluvial and alluvial deposits of considerable thickness, of clay, gravel, sand, mud, &c., mingled together, or in separate layers, in various inclinations to the horizon.

We next come to the rocks, which are generally placed in layers or beds, one above the other. The rocks differ from each other, not only in the materials of which they are composed but in their texture, some rocks presenting a crystalline and chemical union of the materials, and others that of a mechanical aggregation. In the upper series of rocks are found mingled the remains of vegetables and animals, in a petrified state, but in the lower series of the rocks there are few or no traces of such organic remains. The rocks in which no organic remains of plants or animals are found are denominated primary, and those in which such remains are found, secondary and tertiary. The secondary and tertiary rocks are in general disposed in thin layers, one above the other, while the primary are in general disposed in masses, with a crystalline structure, of an unknown thickness. Rocks, when in the former condition, are said to be stratified, and when in the latter unstratified. The stratified are in general composed of a mechanical aggregation of fragments and particles, arising from the decay and waste of some previously existing rocks, whereas the unstratified rocks are more of a molecular and crystalline than fragmentary composition. The stratified rocks are always found to be more or less inclined to the horizon, the inclination, as to quantity, being in a great measure dependent on their proximity to the unstratified rocks.

The composition of the stratified rocks is in general of a sedimentary character, so as to induce a belief of their having been the result of aqueous deposition. That the various materials composing these stratified rocks may have been held in suspension by water while in a state of violent agitation, and may afterwards have been deposited when it assumed a more quiescent state, I am ready to admit; but how in a merely mechanical deposition the materials of one stratum should first be deposited without admixture of particles of the second, and the second in like manner without admixture of the third, I am at a loss to understand; nor am I aware of any fact in the whole range of experimental philosophy which tends to elucidate the point. The strata in Alston Moor, and the neighbouring mining districts to which my personal observations have been chiefly confined, are of the secondary formation, and consist of numerous alternations of limestone, argillacious slate or plate, and sandstone or silicious rocks.

According to one theory, I am to believe that the superposition of these alternating beds of rocks in the certain and determined order in which they are found, has been the immediate result of successive depositions from water. According to another, I am to understand that these strata had been consolidated from loose sand or mud, by an intense internal heat from the interior of the earth. But it is a fact fully established from observation, that the sand, mud, &c., mechanically suspended in water, let their chemical qualities be what they may, are deposited promiscuously together as they are washed away from the land, &c., and not first a deposition of particles of one chemical quality, without any admixture of those of some other chemical quality; and then to a second deposition of particles of some other chemical quality, without any admixture of a third chemical quality, repeating these alternations several times.

The very definite divisions which exist between one stratum and another appeared to me quite different from what might have been expected to be found in a continuous deposition from water. The occurrence of nodules of iron ore in clay, shale, and coal strata, and of flints in chalk, presented another difficulty, for neither their internal structure, nor the promiscuous manner in which they are dispersed, could, I conceive, be accounted for under the idea of a deposition from water.

Another difficulty which presented itself was the greater or less inclination which the stratified rocks were always found to have to the horizon, sometimes approaching to the perpendicular, and the planes of stratification presenting all manner of contortions, being, curved, waved, and angular; whereas all mechanical depositions from water in a quiescent state are always parallel, or nearly so, to its surface (horizontal), and having also all the planes of stratification horizontal. In answer to these objections, it is replied that the stratified rocks are not in their original places, but have been raised up from some unknown depth below the surface of the ocean to their present stations, and, as a consequence of such elevation, would follow the inclination of the strata to the horizon, and the curved, waved, and fractured condition of their planes of stratification.

But when we find hills, mounds, and beds of gravel, sand, &c., regularly stratified in many instances, the layers of which have all the varieties of inclination from the perpendicular to the horizontal, and also presenting all the inflexions and contortions which are exhibited by the stratified rocks about some mass of the unstratified. Therefore, as this condition of hills of gravel, sand, &c., in which no elevation can take place from internal expansion, in the sense in which geologists apply the term to the raising of mountainous masses, render the argument of the elevation of the stratified rocks from the bed of the ocean to their present stations of little avail in explaining their inclined positions to the horizon; nor of the waved and contorted stratification they present.

It thus appears, then, that the phenomena which the stratified rocks present must be accounted for and explained in some other way than by being raised up by a force of variable intensity, acting in a direction from below upwards after their deposition in the ocean. For several years I studied with a strong predisposition to reconcile these and many other discrepancies between the actual phenomenon of stratification and the observed laws of mechanical deposition from water; but multiplied observation seemed only to multiply difficulties, and I became convinced that the true theory of stratification had not yet been promulgated; for alternating layers of rocks of different chemical qualities, superimposed one above another, cannot be the immediate consequence of mechanical deposition from water, but of some agent which possesses a power to select the different particles of a mixed mechanical deposition from each other, and thus by collecting those of the same kind together would form zones, or layers, superimposed one over another.

Being engaged in the study of galvanism, I found it remarked that many other substances besides metals would when piled in alternate layers develope electrical action. It appeared to me, then, as the strata consisted of alternate beds, or layers, of different chemical qualities piled on each other, they might form a species of galvanic battery, and a development of galvanic action might be produced in them, provided there were found to exist some medium uniting the extremities of these enormous rocky piles. Mineral veins, descending from the surface to an immense depth, and being usually filled with some of the more perfect conductors of electricity, appeared to present a sufficient means of uniting the superior and inferior poles of those rocky piles, and thereby bringing their electric powers into operation. Pursuing the subject further in detail, I was led to conclude that each stratum, according to its position in the pile, must possess its own peculiar electric condition, and that were any two contiguous strata in any part of the series to have their positions reversed, the electric condition of the whole series would be destroyed. Also, that if the materials of any two contiguous strata in any part of the series should become mingled together, atom for atom, so as to form a homogeneous mass, the atoms of each stratum retaining their own electrical condition, it appeared reasonable to conclude that the electro-motive action of the superior and inferior strata, bounding the mixed mass, would cause the atoms composing it to be drawn or attracted to their respective polar positions, and that it would thus be converted into distinct zones, or strata, again.

Then, if by the electro-motive powers of the strata the atoms of any interposed mass of the mixed materials of similar strata could be selected and carried to their respective polar positions, it might reasonably be concluded that the same effect would be produced in the case of any other mixed mass of materials which may be interposed between surfaces in different electrical states. And, generally, that if any mass of mixed materials, composed of particles in a different electrical condition, be interposed, so as to constitute a conductor between two surfaces in different electrical states, the particles of the mass will be separated and polarised respectively on the surfaces in an opposite electrical state to their own. The mixed mass being thus formed into distinct strata, more or less perfect according to the energy of the electric action. When the particles have accumulated on the polarising surface to a certain thickness, the electro-motive action will be neutralised, as occurs in a galvanic battery, and the flow of particles will cease; when the stratum, thus formed, will in its turn become the electro-motor in polarising other particles of the mixture which are in a different electrical state.

This alternating operation being repeated until the whole of the mixed materials have been separated into distinct zones, thus forming an alternating series of strata. Now, in the case of a quantity of sand, mud, &c., deposited at the bottom of the ocean, or on the terrestrial surface by the overflowing of rivers, or from being drifted by the wind, we have the above condition exemplified, for there is a mass of mixed materials between two surfaces (in the first case the sea and the solid earth, and in the second the air and the solid earth) in different electrical states; and if our suppositions be correct, such a mass would, by the electric action of these surfaces, be separated into distinct layers of the different materials composing it, that it would be stratified.

The degree of solidity and the texture of the strata might be expected to vary ac-

ding to the thickness of the mass deposited, the intensity of the electrical action.

Such is a brief outline of my views with regard to the stratification of the earth. ese opinions were formed from pure reasoning, several years before I attempted to fy them by experiment.

The following is a brief account of the mode of experimenting, and the results of experiments, instituted with a view to test the accuracy of my conclusions:—My experiment was performed with 28 pairs of cylindrical plates of copper and zinc, from the results of numerous experiments afterwards made, I am led to believe from 18 to 20 pairs answer the purposes of the experiments best. The copper es having a surface of about 9 square inches, the zinc about 6 square inches. The s were placed in jars containing a fluid, consisting of 59-60ths of water, and 1-60ths uriatic acid:

he materials acted upon were limestone and sandstone, reduced to a fine powder, roughly mixed, and made into a paste with water. This mixture was put into a e tube, ½ an inch in diameter and 1¼ inch in length. Metallic discs fitting the s of the tube having been soldered to the ends of the connecting wires of the batwere inserted so as to constitute the materials in the tube a part of the connexion ween the poles of the battery.

he experiment was continued until the battery became null, and the result was a fied appearance of stratification, although the separation of the materials was but y imperfect. The materials operated on were firmly united, especially those in middle, and adhered to the glass so strongly that it was impossible to separate m without breaking it. The battery soon became null, and considering that the ration as performed by Nature must be more slow and gradual, and hence take e time for its completion, than that in the above experiment, I resolved in future use common spring water, instead of the acidulated water. In all my experiments performed since, I have used water only as an exciting fluid.

t may be proper to state that the position in which the tubes are placed has no inence on the results; for I have placed them in every position, from the horizontal the vertical, without being able to perceive that the experiments were at all afed by the change, the stratification always being at right angles to the current.

My second experiment was performed with the same battery as before, but the exing fluid was water. The action was continued eight days, at the end of which I extracted the mass from the tube: the separation was more perfect than in first experiment, but there was less consolidation, the materials easily crumbling o powder by an edged instrument. This may be attributed to the limited time ring which the action was continued.

n none of the experiments has the separation of the materials been thoroughly fect, the larger particles continuing mixed with each other. But this feature of experiment cannot be taken as an objection to the experiment, being confirmaby of it, as it is in accordance with the phenomena which the stratified rocks generally present, none of them being perfectly pure, and, besides, frequently containing ments of rock of a nature different to their own.

The limestone was collected on the negative or zinc end of the battery, and shale the positive or copper end, and this was the position taken by the materials in all other experiments, without a single exception. In my third experiment the maials operated upon were limestone, sandstone, and argillacious shale, pounded and ed as before. In ten days a very distinct, though not entire, separation was efted—the limestone occupying the negative end, the shale the positive, and the stone being collected in the centre. The induration of the limestone and shale s but slight, the sandstone was much more compact and solid.

For upwards of six months, during the latter part of the year 1836, I had two, and times three, batteries of from 20 to 30 pairs of plates operating on different rocky ctures, and at several times since for two or three months together. The results of experiments were generally such as above stated, tending most decidedly to conm me in the opinion I had formed with regard to the stratiform arrangement of rocky materials of the earth. When the materials operated on are of different ours, the progress of the separation can be observed through the tubes in its vari stages, and is exceedingly interesting. When my batteries have been clean and ly fitted up, I have in many instances effected very distinct separations of the terials in two days.

t may be proper to state, that silver and tin answer best for discs to insert in the es on each side of the materials. When the materials operated upon were limene and shale, and their separation into zones, or strata, had been effected by the ion of a gentle current, and if there were afterwards connected with the battery in action another of equal power, the stratification of the materials became vaously waved and contorted, and also irregular in thickness. And when the current s made very energetic, by uniting three or four batteries with the one already in ion, by which the stratification of the materials had been effected, the materials ected at the positive or copper end of the battery would be gathered into irregular sses, and pushed up into the other materials, and in some cases would be carried nearly through them in their variform masses, like faults and dykes. The way which electro-mechanical transference of the particles of rocky substances is effected ar be most easily understood, by observing the action of an electrified body on parcles of dust, or on a piece of fused sealing wax, or that of a magnet on iron-filings.

TRIAL OF PATENT CAUSES—No. V.

Sir,—I pass now to the consideration of the third plan proposed to be discussed—, "The system of referring the patent in question, with the objections raised to it, the Patent Commissioners, in order that the points in issue between the parties may reported on by the proper officer or officers acting under their authority, before the se goes down for trial in the ordinary courts of law."

To some persons this plan will probably appear on its first announcement to be a re compromise between the present system and that considered in my last letter; is, therefore, desirable that its positive points should be clearly understood by all se who are anxious to promote real improvement in a matter involving such vital nsequences to all patent property as that of an efficient tribunal for trying and uring its rights. But it would occupy too much of your space for me to attempt lay before your readers anything like a full statement of such points, so that though I should be prepared to discuss them in detail, I will content myself for present with merely noticing the salient features of the above plan. And these y be regarded under two heads:—1. The authority of the preliminary report. 2. Its probable intrinsic quality.

There can be no doubt of the sufficient legally constituted authority of the Commisners of Patents to induce any judge to pay all due respect to any report issued er their sanction. Their personal authority is also of sufficient weight to influence ourt of law to the extent required for the proper working of the proposed system. his will at once appear when we consider that the following learned persons are comsioners:—The Lord Chancellor, the Master of the Rolls, Her Majesty's Attorneyeneral for England, Her Majesty's Solicitor-General for England, the Lord Advocate, er Majesty's Solicitor-General for Scotland, Her Majesty's Solicitor-General for eland, and Her Majesty's Attorney-General for Ireland.

No court of law would venture to treat slightingly the acts proceeding from a body ossessing in itself so distinguished a combination of official and personal authority, t probably the chief difficulty that suggests itself is as to the manner in which ch a body can act in unity by delegating their authority to competent hands, for is not reasonable to expect so many important functionaries to be able to give their ntion to each case. This difficulty, however, would be far greater, and perhaps many cases insurmountable, if they were required to agree to a report on points general law. But it is quite a different subject on which it is proposed that they ould sanction a report—viz., on practical points relating to manufactures. In tent cases the law cannot be applied until these points have been ascertained, and e necessity for the law officers to have assistance on scientific questions is expressly knowledged under the new law of patents, and occasionally acted upon; as indeed was even under the old law.

It is a common practice for the Attorney-General or Solicitor-General to refer a tent opposed at the notice to proceed, or for the Lord Chancellor to refer a patent posed at the Great Seal, to Mr. Woodcroft or other scientific person, who furnishes report to the law officer, as to the points relating to the manufacture involved in e proceedings, upon which report the law officer acts. It does not appear, then, at the Patent Commissioners, acting singly, think it at all derogatory to their digity to rely upon the report of a scientific referee in matters of science or relating to anufactures, and a single commissioner thus acting, does so with the sanction of the hole body, for aught that appears to the contrary. And it cannot be said that the tters at present dealt with by single commissioners are unimportant. The law fficer can, and often does, stop an application for a patent at the warrant, and the ord Chancellor can, and occasionally does, stop an application at the Great Seal. In th cases the applicant is prevented from going any farther by the act of the single ommissioner.

I think, then, that in principle the delegation of authority from the whole body of ommissioners to a working number of them, and to scientific referees, is already reognised as required for the regulation of patent practice. What I wish to see done , that this principle should be acted upon to an increased degree, so as to be capable ensuring uniformity of official practice where the principle is at present recognised, nd to extend its application to the dealing with all preliminary questions of objecons raised to patents.

It would extend the limits of this letter too much to enter upon a consideration of e second head—viz., "The probable intrinsic quality of the preliminary report," hich must accordingly be deferred to my next. WILLIAM SPENCE.

Office for Patents, 59, Chancery-lane, Oct. 27.

P.S. I ought last week to have noticed Mr. Mushet's letter, so far as to explain that e seemed to mistake me for some one else, as I neither am nor ever have been conected with the Great Seal Patent Office, but have been for upwards of 17 years an dependent private practitioner, and I am now merely submitting some of the reults of my experience to the attention of patentees.

ATMOSPHERIC APPARATUS FOR THE TRANSMISSION OF SIGNALS.—Mr. W. P. Maddison, of Barnsley, has patented an improved method of signalling, atmospheric air being the communicating agent. It is anticipated this will supersede ells, and all descriptions of signals by wires, and can be used everywhere that it is requisite an instant communication should be made. He does not take credit to himself as being the first person who has made the endeavour to perfect an atmospheric telegraph, but only to an improved method, which improvement consists in allowing the air in the communicating tube to have free intercourse with that of the air surrounding it, and having a small cylinder attached to the signalling end, in which works a piston, which does not work air-tight in the cylinder. By the former method the tube was dependent on atmospheric changes, and would be too fickle in its action to be of any service in a length of tube. To obviate this difficulty, Mr. Maddison employs a continuous length of gutta percha tubing, or any other material. To the one end he attaches a small bellows, elastic or otherwise, and to the other end a small cylinder, about the same diameter as that of the tube employed, or not more than ½ in. diameter, and 6 in. long. Within this cylinder a piston is inserted, working quite free and loose, so that air will pass between it and the cylinder, and there will be no friction whatever caused by the working of one against the other. On the top of the cylinder holes are made, to allow the air above the piston to have perfect liberty, the moment any pressure is exerted on the under side of the piston. From the piston rises the piston-rod, to the top of which is attached a small weight or hammer, and above it a bell, so fixed as to be within the range of stroke of piston and rod. The evident result of such arrangement is that a momentary pressure, slight but positive, is exerted on the bellows; the whole of the air is driven forward, and displaced to a certain extent, varying with the amount of pressure on the bellows. The effect produced is instantaneous, or, at all events, no appreciable space of time elapses between the power exerted and the effect produced. The inventor takes power in his patent to construct his signalling apparatus, so that it shall work a pointer or needle, similar to that in use by two electric telegraphs, so as to give and receive messages between the given points, as well as a backward and forward motion of the pointer, as may be required from either extremity of the tube.

*** MINING JOURNAL.—The VOLUMES for 1854 and 1855, perfect, with Index and Title-page, strongly bound, to be sold—price 2*l.* each.

INSPECTION OF COAL MINES.—No. II.

In a late *Journal*, we showed that in the Durham, Northumberland, and Cumberland district (Matthias Dunn) the number of accidents, during the half-year, in shafts was 18, being 5 above the half-yearly average for the preceding 4½ years. At Ludworth Colliery, a life was lost by the engine being reversed, and the cage suddenly drawn up against the pulley; this occurred from an inexperienced young man being allowed to handle the engine for a moment, which was proved to be inconsistent with the written rules of the colliery. A similar case occurred at Harraton; the regular onsetter at the bottom of the shaft being wanting, the overman appointed a young man in his place, who was an utter stranger to the business, and neglected to give him any verbal instructions as to the signals, whilst the colliery was also wanting in written rules. Two persons had entered the cage to ascend the pit, and the third was in the act of entering, when the brakeman swore that a signal was given to draw away; the consequence was that the poor man was so squeezed at one of the buntons across the shaft that he died the following day. Both the parties were tried at Durham Assizes, and acquitted, it being proved that in the latter case the overman did not acquaint the strange onsetter with the nature of the signals. Six several persons have lost their lives from falling down shafts and staples, which species of accident may be expected to diminish, in consequence of the guards prescribed by the recent Act, whilst the remaining deaths have been mostly from crushes of the cage.

The deaths from explosions were 11 in number, being 3½ below the half-yearly average for the preceding 4½ years. The cases at Usworth (Aug. 24) and Monkwearmouth (Sept. 12) both occurred with deputy overmen, who were accounted experienced men and good judges: in both cases they were furnished with safety-lamps, but in an unguarded moment exposed the naked lights to the inflammable air current. The explosion at Crosby, Cumberland (Oct. 23), took place in a sinking pit, which not being understood to be making gas was partially scaffolded over during some operations in the upper part of the shaft, and the gas being thus left to accumulate below, fired upon the workmen, and the two men were precipitated to the bottom, where the after-damp was so strong that it was many hours before the bodies could be recovered. The explosion at Burradon (Sept. 17) took place from one of the hewers being allowed to hole into a board which was known to be foul, and that, too, unnecessarily, so that the investigation bore a serious appearance, as implicating the overman in want of care, but a verdict of accidental death was recorded. The explosion at Page Bank sinking pit (Sept. 26) was very similar to that at Crosby; a blower of inflammable air had got on fire in the shaft, and in order to extinguish it they covered over the top of the pit, but having brought a naked light near to the place the accumulated gas took fire, blew away the scaffold, and caused the death of one man; the same pit, some months afterwards, fired at the small ventilating furnace, and occasioned great alarm, rendering it necessary to line the shaft with an air-tight casing of deals to convey the gas to surface, it being remarkably violent under certain changes of the weather.

The remainder of the casualties demand no especial notice. The number of deaths from falls of coal and roof is 4 above the average, and from sundry causes (a great proportion of which have originated from crush of tubs in the workings), exactly the average, 23. The total half-yearly average for the 4½ years ending June 30, 1855, was 74, whilst the total number of accidents in the half-year ending December 31 was 79, being an increase of 5, which must be attributed to the gradual increase in the quantity of coal raised, and the consequent increase of risk, as with few exceptions great care is taken to avert danger. This report includes the district which is now allotted to Mr. J. J. Atkinson.

PURIFICATION OF IRON.—Messrs. C. M. Tessié du Motay, and J. J. Fontaine, of Paris, have patented an invention for purifying and decarbonising cast-iron simultaneously either in puddling or finery furnaces, so as to convert it into wrought-iron having the properties of steel. This end is attained by the use of artificial fluxes or chemical agents, re-acting either together or separately on the cast-iron during its reduction to the state of wrought-iron, without in any other way changing the ordinary puddling or refinery processes. The artificial fluxes may be prepared in either of the following modes:—1. Melt the scoria commonly employed in puddling and finery furnaces with silicate of alumina, obtained either from clays, feldspaths, refractory earths, or from marles, or any other silicates of alumina, combined with silicates of the alkalies, alkaline earths, or metallic oxides. Add to this flux, before or during its fusion, a bi-carbonate of potass or soda, and then a silicate of the protoxide of iron, or any other anhydrous silicate.—2. Melt the scoria with silicate as before. Refine or puddle cast-iron in this flux. During this refining or puddling, the oxides of iron produced unite with this flux, to which add a silicate of protoxide of iron, or any other anhydrous silicate. Artificial fluxes constituted according to one of the modes above described are run out and allowed to cool. Then line the puddling furnaces or refinery crucibles with the silicates and oxides of iron commonly employed for refining and puddling cast-iron. With these silicates and oxides either the first or second artificial flux may be melted, and the cast-iron refined or puddled in this flux. When the cast-iron is in part decarbonised, throw into the refinery crucible or into the puddling furnace, either a hypochlorite of potass, of soda, of lime, of magnesia, or of strontia, or baryta, or a bi-carbonate of potass or soda. The basic carbonate of magnesia can also be employed. The salts above-mentioned may be replaced with double salts, or by the following mixtures of salts and oxides:—Carbonates of iron and potass, carbonates of iron and soda, carbonates of iron and lime, carbonates of iron and magnesia, carbonates of manganese and potass, carbonates of manganese and soda, carbonates of manganese and magnesia, carbonates of potass and chloride of potassium, carbonates of soda and chloride of sodium, carbonates of lime and chloride of calcium, carbonates of magnesia and chloride of magnesium, carbonates of potass and chloride of sodium, carbonates of potass and chloride of calcium, carbonates of potass and chloride of magnesium, carbonates of soda and chloride of potassium, carbonates of soda and chloride of calcium, carbonates of soda and chloride of magnesium, carbonates of lime and chloride of potassium, carbonates of lime and chloride of sodium, carbonates of lime and chloride of magnesium, carbonates of magnesia and chloride of potassium, carbonates of magnesia and chloride of sodium, carbonates of magnesia and chloride of calcium; (by carbonates we mean carbonates, sesqui-carbonates, and bi-carbonates of the above-named alkalies); oxides of manganese, chloride of sodium, oxide of manganese, chloride of potassium, oxides of manganese, chloride of calcium, oxide of manganese, chloride of strontium, oxides of manganese, and chloride of barium. The oxides of iron or chromium can be substituted for the oxides of manganese According to the quality of the cast-iron to be reduced, add a greater or less quantity of one or other of the artificial fluxes, or of the salts and oxides. In general the quantity employed does not exceed 5 per cent. of the weight of the crude cast-iron being treated. The hypochlorites, the bi-carbonates, and the other salts and oxides can be employed for the purification of cast-iron, without employing the two artificial fluxes before mentioned, especially if a certain quantity of silicate of protoxide of iron, or of any other anhydrous silicate, is added to the scoria commonly employed for refining or puddling cast-iron. The process is commenced by heating either the puddling furnaces or the refining furnaces to an orange heat, which temperature is necessary for the complete fusion of the metal it is purposed reducing to the state of iron. When the ore (or metal) is in a state of perfect liquefaction, the temperature of the puddling furnaces is lowered by closing the valve of the chimney, and when using refinery furnaces the lowering of the heat is by diminishing the rush of air through the tubes or tuyeres. In proportion as the ore is decarburated and granulated, throw into it either one of the simple salts or one of the compound salts, or again, one of the mixtures of salts and oxides above described. When the metal, more and more refined and decarburated from its contact with the oxides and chemical agents above named, assumes the nature of iron at the surface of the bath, again raise the temperature of the puddling furnaces or refining furnaces to a welding heat, in order to permit the puddling or refining workmen to form the balls. Here terminate the series of operations peculiar to the working of these processes.

IRON-WORKS IN AMERICA.—A correspondent of the *Birmingham Journal* writes:—"The vigour which has marked this branch of industry for the last four years remains unabated; the enlargement of old works still continues, new beds of ore are continually being discovered, and new works erected. Among these last are the iron-works of Wood, Morrell, and Co., at Jamestown, in Pennsylvania, now in full operation. They are situated at the termination of the western division of the Pennsylvania Canal, connected with the river Juniata by railroad. The property of the company consists of 25,000 acres of a rich deposit of coal and iron ore, in one compact body. On it are now complete one rolling mill, thirty double puddling furnaces, twelve heating furnaces, eight blasting furnaces, machine-shop and foundry, besides a number of cottages for workmen; the whole outlay, exclusive of the land itself, being a million of dollars. Its operations are confined to the making of rails, and the latest improvements known here or in England are introduced. The average weekly produce of the works is 450 tons of rails, and the demand at present is greater than the means of its supply. Twenty two hundred people find employment on this property, who are divided as to nationality as follows: Welsh, 1000; Americans, 600; Irish, 400; Germans, 200. The Boonton Works, in New Jersey, which a few years ago were sold by the sheriff, have also for the past year been in full operation, and are enlarging their capacity of production. Like many other American iron-works, they manufacture the greater part of their produce into nails and spikes. This year they will make 145,000 kegs of nails, and 15,000 kegs of railroad spikes, each keg containing 100 pounds. This establishment employs 600 hands in the various operations of mining, smelting, rolling, and nail making. The Highland region of New Jersey, in which these works are situated, extending through three counties, is remarkably rich in iron ore and limestone of excellent quality. The mines have been but little worked hitherto. The uncertainty of the iron trade, and fluctuations in the tariff, have deterred capitalists from investing in the manufacture; but attention is now being directed to them, and if the plans now matured are ever carried out, New Jersey will probably become the greatest iron producing State in the Union. Dr. Kitchell has recently been employed by the State to make a survey and report of this district, with a view of exhibiting its iron-making resources and adaptability. He finds it to possess vast abundance of the "richest of ores," and the "best of fluxes," while its easy accessibility to the anthracite coal fields of Pennsylvania, and its proximity to New York and Philadelphia, combine every advantage that could be desired. The report enumerates and describes nearly 100 mines of iron ore in the three counties, in some of which the ore deposits are immense. New companies have already commenced working some of the mines, and others are being formed to open more. The Andover Mining Company will produce this year 15,000 tons, the Glendon 12,000 tons, the Mount Hope somewhat less, the Mount Ferrum, the Hibernia, the Wood Mine, the Willing, and eight other new mines that I could enumerate, will each add to the quantity hitherto taken from this region, while other companies not yet at work will help next year to swell the increase in the national production of iron to an amount that may be sensibly felt in the iron markets of both countries."

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,, coal	11 2 0 0	9 3 0 0
,, coke	0 2 0 0	0 1 26 0
,, ashes	1 0 6 13	1 0 10 3
,, clinker	0 0 11 3	0 0 10 1

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DEVON WHEAL DUCHY.
This is in a piece of hitherto-neglected, but very promising, mining property, although formerly considered one of the richest in Devonshire for tin. The stratum is a beautiful clay-slate, forming a junction with the granite; it is the nearest mine to the granite hills of Dartmoor, in the parish of Whitchurch. It is situated to the east of Devon Burra Burra, Whitchurch Consols, and East and West Sortridge, all the lodes of which run through this sett. It has Huckworthy Bridge Mine and North Wheal Robert to the south; and the Great Wheal Friendship to the north, which has been yielding dividends for the last 50 years.
The ancient miners have done a great deal on the banks of the tin lodes.
There are two very promising lodes laid open, one a tin lode, sunk 4 fms., with good stones of tin, the other a very fine copper lode, 7 feet wide, composed of gossan, prian, and mundic, with good spots of copper, with every appearance to warrant a course of ore at no great depth, with several other tin and copper lodes not yet wrought upon.
There is a very important point in working this mine—that is, by the aid of water machinery, as all the water which goes to North Robert, Sortridge Consols, and Great Sortridge, run all the length of the sett, which is nearly two miles long and more than one mile wide. All practical miners acquainted with this piece of mining property, come to the conclusion that it is an excellent adventure.
Any mining capitalist who would like to engage in such a promising piece of mining property, may obtain all necessary information by a letter directed to "R. T.," Moor's Shop, Whitchurch, Devon.
There is another important feature connected with this sett, and that is the immense and highly-metalliferous cross-course which passes through the Wheal Friendship and Devon Burra Burra Mines, which takes its bearing to the west of this sett. There has been but one mine tried by this cross-course, which is between the granite and killas, and that is Wheal Friendship, which has been very successful; and there is not the least doubt, if tried on east and west lodes, by this cross-course, they will make large deposits. 165

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Capital £50,000, in 5000 shares of £10 each. Deposit £5 per share.
£1 per share to be paid on application. 166
Applications for the 2500 shares unsold may be made in the printed form, and addressed to the offices of the company, 9, Austinfriars, where prospectuses can be obtained.
WILLIAM EVANS, Secretary.

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FORM OF APPLICATION FOR SHARES.
To the Directors of the Treburgett Crowan Consolidated Copper Mining Company (Limited).
Gentlemen,—I request you to allot me shares in your company, of £10 each, on which I enclose you a deposit of £1 per share, and hereby undertake to accept such shares, or any less number, and to pay the further sum of £4 per share on allotment, and the further calls as required, up to £10 per share, subject to the provisions of the Act of Parliament which limits liability to shareholders.
I am, Gentlemen, your obedient servant,
Name in full.....
Residence .....
Profession or business .....

ELECTRO-CHEMICAL REDUCTION AND SEPARATION OF METALS FROM THEIR ORES.
By Her Majesty's Royal Letters Patent. 168
Patentees—Matt. French Wagstaffe, Esq., M.R.C.S., Walcot-place West, Lambeth; John William Perkins, Esq., F.C.S., Poplar-terrace, Poplar.
Licenses can be obtained for the use and adoption of the process on application to the patentees, at No. 2, Poplar-terrace, Poplar; where demonstrations on a large scale may be witnessed, and where mine owners and others may send ore for treatment. Analyses and assays of small samples will be made at a nominal charge.
London, Oct. 17, 1856.

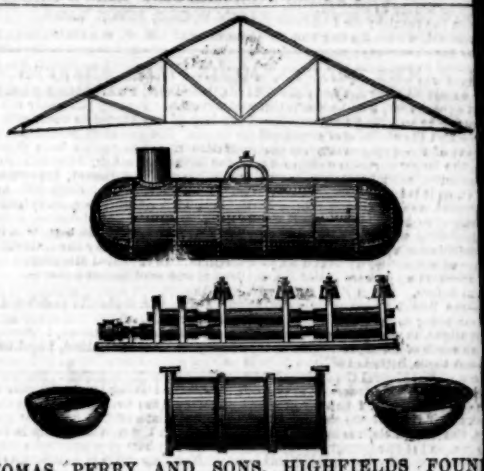
SLATE.—The BANGOR ROYAL SLATE COMPANY have ON HAND a large assortment of ROOFING SLATES, BLUE and GREEN, of the usual sizes, which they are prepared to SUPPLY on the usual terms, for shipment from their depôt at Bangor, or to transmit by railway; also, SLABS of all sizes.
Orders to be addressed to Mr. Edwards, manager, Royal Slate Quarries, Bangor. 169

SLATE SLABS AND ROOFING SLATES.—The PROPRIETORS of the NEW MACHNO SLATE and SLAB COMPANY (LIMITED) have, at great cost, made arrangements to convey their produce from their quarries near Ffestiniog to Conway, to obtain the great advantage of access to the railway, giving them the facility of executing orders without the slightest delay. They trust that making Conway their shipping port will not cause them to be confounded with those hitherto known as the CONWAY SLATES, as the MACHNO SLATES are ENTIRELY FREE from PYRITES, or any metallic substance liable to OXIDATION; and, from having been tested in Wales for at least half-a-century, are found to attain a degree of hardness, by exposure to the atmosphere, unknown in any other vein. The MACHNO SLABS are too well known to need comment, but the annexed valuable testimonial from Mr. Magnus, and also a strong chemical test to which they have been subjected, will better explain their quality:—
Pimlico Slate Works, Upper Belgrave-place, London, April 7, 1855.—Gentlemen: I very readily offer my testimony to the excellence of your slabs raised at the Machno Quarries. I prefer them to all others obtained in North Wales, with one exception, and that is much of the same quality as the Machno. The slabs can be obtained of large sizes, and of every requisite thickness. They are homogeneous in texture, strong, of good colour, free from spots and other impurities, pleasant to the tool of the mason, easily planed and moulded, and will bear exposure to a much higher degree of heat than slabs from any of the Carnarvonshire quarries.
Signed, G. E. MAGNUS.
To the Proprietors of the Machno Slate and Slab Quarries.
Liverpool, Oct. 13, 1855.—Dear Sir: The experiments which I have tried on the specimen of slate, in reference to its capability of resistance to acids, enable me to pronounce it in every way capable of retaining boiling vinegar, without injury either to its own substance, or to the contained vinegar. A piece of the slate, weighing 95 grs., was exposed for 26 hours to the action of cold strong nitric acid; it was then boiled in the same acid for 20 minutes, and when washed, dried, and weighed, was found not to have lost perceptibly in weight. This I consider the most conclusive experiment.
Signed, GEO. C. HUSON.
Wm. Orme Carter, Esq., Machno Slate and Slab Company.
All communications must be addressed to the resident director, Mr. T. H. Wheeler, Conway, North Wales. 170

IMPROVED LIFTING JACKS,
MANUFACTURED BY
W. AND J. GALLOWAY,
PATENT RIVET WORKS,
MANCHESTER.
The attention of parties who employ
Lifting Jacks,
Is respectfully requested to the superiority of those annexed, over those hitherto in use.

TO MARINE ENGINEERS, SCREW SHIP COMPANIES, AND MACHI GENERALLY.
THE NEW PATENT MULTIPLE ROTATIVE GEARI
This justly admired invention contrasts with the ordinary toothed gea which it is proposed as a substitute, and possesses the pre-eminent adva COMPACTNESS, STRENGTH, D LITY, FREEDOM FROM NOI BACKLASH, UNIFORMITY and SM NESS of ACTION, REDUCED FRI FACILITY for LUBRICATION a PAIR, and virtually WITHOUT ACCIDENT, advantages unequalled other arrangement of gearing. It is for all purposes where a change of required, and is peculiarly applica screw propulsion.

The proprietors of the patent are p to GRANT DISTRICT and OTHE CENSES for the manufacture of thi ing, or to ENTER INTO CONTRA the adaptation of the invention to screw steam-vessels, or other machiner application to their agent, No. 3, Hanover Chambers, Buckingham-street, where any further particulars may be obtained, and models and testimonials in
The invention was honourably mentioned by the International Jury at the Exhibition of 1855; and has been favourably noticed in the *Artisan* of June an 1855, and the *Mining Journal* of 8th December, 1855. Manufacturers treat on the most liberal terms. Communications by letter post paid.



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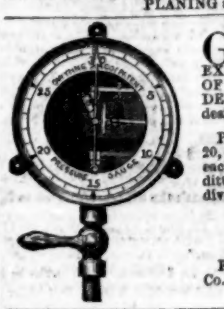

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